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COMPARATIVE VERIFICATION OF GUIDANCE AND LOCAL AVIATION/PUBLIC WEATHER FORECASTS--NO. 7
(October 1978 - March 1979)

Karl F. Hebenstreit, Joseph R. Bocchieri, Gary M. Carter,
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1. INTRODUCTION

This is the seventh in the series of Techniques Development Laboratory (TDL) office notes which compare the performance of TDL's automated guidance forecasts with National Weather Service (NWS) local forecasts made at Weather Service Forecast Offices (WSFO's). The local forecasts, which are produced subjectively, may or may not be based on the automated guidance. We present verification statistics for the cool season months of October 1978 through March 1979 for probability of precipitation, precipitation type, surface wind, opaque sky cover, ceiling height, visibility, and maximum/minimum (max/min) temperature.

The objective guidance is based on equations developed through the Model Output Statistics (MOS) technique (Glahn and Lowry, 1972). We derived these prediction equations by using archived surface observations and forecast fields from the Limited-area Fine Mesh (LFM) model (National Weather Service, 1971), the Trajectory (TJ) model (Reap, 1972), and/or the 6-layer coarse mesh Primitive Equation (6LPE) model (Shuman and Hovermale, 1968). In operations, however, forecast fields from the LFM-II (National Weather Service, 1977a) and the 7-layer PE (7LPE) model (National Weather Service, 1977b) are employed in the MOS guidance equations when LFM or PE data, respectively, are required. Unless indicated otherwise, we usually refer to MOS forecasts based on the LFM-II as "early" guidance; "final" guidance indicates that the objective forecasts were dependent on the 7LPE. Also, the observation times of surface weather elements used as predictors in the early and final guidance generally differ.

The local forecasts from the WSFO's were collected by the Technical Procedures Branch of the Office of Meteorology and Oceanography for the purposes of the NWS combined aviation/public weather verification system (National Weather Service, 1973). These forecasts were recorded for verification according to the direction that they be "...not inconsistent with..." the official weather prognosis. Surface observations as late as 2 hours before the first valid forecast time may have been used in the preparation of the local forecasts. We obtained the observed verification data from the National Climatic Center in Asheville, North Carolina.

2. PROBABILITY OF PRECIPITATION (PoP)

The objective PoP forecasts were produced by the cool season prediction equations described in Technical Procedures Bulletin No. 244 (National and the final guidance were more accurate for the first period than the previous season. Recall that starting with the cool season 1977-78 the final and early guidance have been identical in the first period. For third period forecasts, the local forecasts and the early guidance were more accurate than the previous season, but the final guidance was less accurate. Several "long term" trends are evident. First, the accuracy of both guidance and local forecasts has increased since the 1973-74 winter season. Secondly, as the 12-24 h MOS guidance has improved, the difference between the guidance and the local forecasts has decreased. Note that results for the 1975-76 season were unavailable because of missing data. In addition, the 1977-78 scores for the third period were based on less than a full season of data.

3. PRECIPITATION TYPE

A new TDL system for predicting the conditional probability of precipitation type (PoPT) (Bocchieri, 1979) was made operational within NWS in September 1978. This system evolved from the probability of frozen precipitation (PoF) system (Glahn and Bocchieri, 1975; Bocchieri and Glahn, 1976; and National Weather Service, 1976) which became operational in November 1972. The PoPT forecasts replaced the PoF forecasts in the MOS early guidance FOUS12 bulletin (National Weather Service, 1978b); the PoF forecasts remain unchanged on the final guidance FOUS22 bulletin.

The PoPT system gives conditional probability forecasts for three precipitation type categories: frozen (snow or ice pellets), freezing (freezing rain or drizzle), and liquid (rain). Precipitation in the form of mixed snow and ice pellets is included in the frozen category; all other mixed precipitation types are included in the liquid category. Here, the frozen, freezing, and liquid categories will be referred to as simply snow, freezing rain, and rain, respectively. The main difference between the PoPT and PoF systems is that freezing rain forecasts aren't explicitly available in PoF, that is, freezing rain is considered as rain in PoF. Another difference is that the PoPT forecasts are transformed so that a "best category" is also provided operationally; in PoF, a categorical forecast isn't available.

In the NWS verification, local categorical forecasts of precipitation type made at about 1000 GMT are recorded for the valid times 1800 GMT (today), 0600 GMT (tonight), and 1800 GMT (tomorrow). Note that this is a conditional forecast, that is, a forecast of type of precipitation if precipitation occurs. Therefore, a precipitation type forecast is always recorded. The PoPT and PoF guidance forecasts are also conditional and are available whether or not precipitation occurs.

Table 3.1 lists the 62 stations used in this verification. We included only cases when precipitation actually occurred. We were concerned that the forecasters may not have put much effort into making the conditional forecasts when they considered precipitation to be unlikely. Therefore, in order to isolate those situations when the forecaster thought precipitation a definite possibility, we used only the cases when the local PoP was $\geq$ 30%. The PoPs were valid for the 12-h periods centered on the 18-, 30-, and 42-h projections used in the verification.

order to isolate those cases when the forecaster would have been more confident that precipitation was to occur. Third, starting in the 1976-77 season, we verified the early PoF guidance for the 18-h projection. Finally, in the 1978-79 season, the early PoF system was replaced by the PoPT system, and the PoPT forecasts were verified for both the 18- and 42-h projections.

The results indicate that the guidance was consistently better over the 6 years except during the 1977-78 season when guidance and local forecasts scored the same at the 18-h projection. There was definite improvement, especially for the locals, over the span of the first 4 years. However, the skill of the guidance and locals generally decreased during the last 2 seasons. The observed deterioration of the skill score could have been caused in part by model changes at NMC. The final guidance equations were developed using 6LPE model output, but have been driven by 7LPE model output since January 1978. The early guidance equations operational during 1977-78 were based on LFM model output, but were driven by the LFMII model. By the 1978-79 season we were able to include some LFMII model output in the development of the new early guidance equations. This may account for the fact that the early guidance skill remained unchanged in the face of the otherwise general decrease in skill.

4. SURFACE WIND

The objective wind forecasts were generated by early and final guidance equations valid for the cool season (see National Weather Service, 1979). The definition of the objective surface wind forecast is the same as that of the observed wind: the one-minute average direction and speed for a specific time. Operationally, the early guidance was based on output from the LFM-II model, while the final guidance relied on 7LPE model forecasts. The sine and cosine of the day of the year also were used as predictors in both sets of guidance equations.

Since the local forecasts were recorded as calm if the wind speed was expected to be less than 8 knots, we verified the wind forecasts in two ways. First, for all cases where both the local and guidance (early and final) wind speed forecasts were at least 8 knots, the mean absolute error (MAE) of speed was computed. Secondly, for all cases where both local and guidance forecasts were available, skill score, percent correct, and bias by category (i.e., the number of forecasts in a particular category divided by the number of observations in that category) were computed from contingency tables of wind speed. The seven categories were: less than 8, 8-12, 13-17, 18-22, 23-27, 28-32, and greater than 32 knots. Table 4.1 lists the 94 stations used in the verification. Tables 4.2 - 4.12 show comparative verification scores (0000 GMT cycle only) for 18-, 30-, and 42-h projections. Note that all the objective forecasts of wind speed were adjusted by an "inflation" equation (Klein et al., 1959) involving the multiple correlation coefficient and mean value of wind speed for a particular station and forecast valid time.

The results for all 94 stations combined are shown in Tables 4.2 and 4.3. The MAE scores for direction show that the guidance--particularly the early --was considerably better than the local forecasts. The speed MAE's, skill scores, and percents correct also were better for the guidance. In addition, the early guidance scores were superior to those for the final guidance. Note, however, that the biases by category in Table 4.2 and the contingency tables in Table 4.3 indicate that both types of guidance and the local forecasts tended to underestimate winds stronger than 17 knots (i.e., categories 4, 5, 6, and 7).

final guidance and local forecasts were identical, and the skill scores of the 42-h forecasts were nearly the same. The 18-h early guidance forecasts, although declining in skill from last cool season, remained superior to the final guidance and local forecasts. Also, the 42-h early forecasts were considerably better than the locals and final guidance at that projection.

Fig. 4.4 depicts a comparison of guidance and local skill scores computed on two categories; the first category contained all speeds less than or equal to 22 knots, while the second category included speeds greater than 22 knots. In this manner, we attempted to directly assess the skill of the guidance and local forecasts in regard to predicting strong winds. Similar to the results in Fig. 4.3, the skill of the final guidance for the 18- and 42-h projections increased during the first 5 years, but decreased this past cool season. In contrast, the local forecasts for the 42-h projection showed very little improvement throughout the 6 year period.

The 18- and 42-h early guidance MAE's and skill scores in Figs. 4.1 - 4.3 generally indicate the superiority of the early over the final guidance. This is quite encouraging because the early guidance is now the only source of detailed surface wind guidance available to NWS field forecasters prior to issuance of the public weather forecast.

5. OPAQUE SKY COVER

The operational prediction equation set was unchanged for the 1978-79 cool season. The early guidance set uses LFM-II model output and 0300 (1500) GMT surface observations to produce forecasts at 6 hour intervals from 6 to 48 hours after 0000 (1200) GMT. The final set uses LFM-II and 7LPE model output and 0600 (1800) GMT surface observations to produce forecasts at 6-hour intervals from 12 to 48 hours after 0000 (1200) GMT.

The regionalized equations produce probability forecasts of four categories of opaque sky cover, more commonly known as cloud amount, as shown in Table 5.1. For both the early and final guidance packages, we convert the probability estimates to a single "best category" forecast in a manner which produces good bias characteristics, that is, a bias value of approximately 1.0 for each category. For more details about our cloud amount forecast system, see Technical Procedures Bulletin No. 234 (National Weather Service, 1978a).

We compared the local forecasts at the 94 stations listed in Table 3.1 with a matched sample of early and final objective forecasts. The comparison was conducted for 18-, 30-, and 42-h forecasts from the 0000 GMT cycle only. The local forecasts and the surface observations used for verification were converted from opaque sky cover amount to the categories in Table 5.1. Four-category, forecast-observed contingency tables were prepared from the transformed local and best-category objective predictions. Using these tables, we computed the percent correct, Heidke skill score, and bias by category.

The results for all stations combined are shown in Table 5.2. There was only a slight difference in the scores for the guidance forecasts. Clearly, categories (categories 1 and 2 combined versus categories 3 through 6 combined) and calculated the bias and threat score for categories 1 and 2 combined and the Heidke skill score and percent correct for the reduced tables. We have summarized the results in Tables 6.2 - 6.9. The Heidke skill score and bias for categories 1 and 2 combined are also given in Tables 6.10 - 6.17 for the last 4 cool seasons.

Tables 6.2 - 6.5 present the results for the six-category ceiling and visibility forecasts for all 94 stations (see Table 3.1) combined and Tables 6.6 - 6.9 provide scores for categories 1 and 2 combined (i.e. ceilings less than 500 feet and visibilities less than 1 mile). Note that the six-category guidance was usually more skillful than persistence for projections beyond the 12-h projection (the exception was for the 18-h projection for visibility during the 1200 GMT cycle). The two-category skill scores show that the early guidance was generally poorer than persistence at the 18-h projection. The skill of local forecasts for both the six- and two-category tables exceeded that of the guidance at the 12-h projection, but never exceeded the skill of persistence (which is available to the local forecaster) for that projection. At the 15- and 21-h projections, the six-category skill of the locals was greater than that of persistence except for visibility at 15-h from the 1200 GMT cycle. The skill scores from the two-category tables show that the locals failed to beat persistence at 15- and 21-h for ceiling forecasts from the 0000 GMT cycle. Also, at the 12-h projection, final guidance, which uses the 0600 (1800) GMT surface observation, was consistently more skillful than early guidance, which uses the 0300 (1500) GMT surface observations. These results reflect the well-known decay with time in skill of forecasts made from the latest observation. We note little difference in skill between the early and final guidance at the longer projections.

The purpose of using the threshold probability technique to select the "best" category for ceiling and visibility was to improve the bias characteristics of the guidance forecasts. The bias-by-category scores show that for most projections the guidance had better bias scores than either the local or persistence forecasts. The biases of the 36-h persistence forecasts (actually a 27-h projection) should be as good as those of 12-h persistence (actually a 3-h projection). Tables 6.2 - 6.9 show this to be true.

Tables 6.10 through 6.13 present the Heidke skill scores computed from two-category contingency tables and Tables 6.14 through 6.17, the bias of categories 1 and 2 combined for the last 4 cool seasons. Figs. 6.1 - 6.7 present selected portions of these data for the 0000 GMT cycle for projections of 12, 15, 18, and 21 hours. The sample size for the 1976-77 cool season was relatively small (Feb. 8 - March 31) which may be a contributing factor to the flucuations in most of the graphs for that season. In general, these data show that the guidance bias characteristics for the difficult-to-forecast low categories have improved with the adoption of the threshold technique during the 1976-77 cool season. At the same time, the skill scores for the guidance have improved slightly over those of 1975-76, but exhibit variation from year to year.

48 (max), and 60 (min) hours after 0000 GMT were verified.

Verification results are shown in Table 7.1 for all stations combined. For the two projections of the max, the early guidance had a mean algebraic error of 0.0°F while the final guidance tended towards a cold bias (algebraic error < 0.0°F). In contrast, both the early and final min guidance were too warm (algebraic error > 0.0°F). Note that the local forecasts exhibited the same type of algebraic errors as the MOS guidance; for all projections, however, the local bias was more pronounced.

At all projections but the last, the early guidance was more accurate than the final in terms of mean absolute error. This was a dramatic reversal from the 1977-78 cool season (Gilhousen et al., 1979) when the final was consistently better than the early guidance. Even in the last projection, the early guidance was only 0.1°F less accurate in mean absolute error than the final. We believe that the new LFM-derived equations (Carter et al., 1978) were the primary cause for the improvement in the early guidance. Unfortunately, there was also a serious error in the 7LPE-based TJ model which contaminated the final guidance during December, January, and February. We're unable to estimate the amount of deterioration that this caused. Note that there were only small differences in the accuracy of the local forecasts and the early guidance. While the local forecasts improved on the early guidance by 0.1°F mean absolute error in three of the four projections, for the 36-h min the early guidance actually had fewer large absolute errors (> 10.0°F) than the local forecasters.

It is of some interest to compare the accuracy of this year's forecasts with that of the 1977-78 cool season (Gilhousen et al., 1979). For the max forecasts, the local and the early guidance for the 1978-79 season had nearly the same mean absolute errors as the local and final guidance of last season. In contrast, however, this year's local and early forecasts of the min were noticeably (0.3°F mean absolute error) less accurate than were the locals and final guidance for last season. Natural variability in meteorological conditions and, consequently, in the difficulty of forecasting the min would seem to explain this deterioration. We also examined verification scores for the Eastern, Southern, Central, and Western Regions (Tables 7.2 - 7.5, respectively). The improvement of the early guidance relative to the final guidance was generally evident on a regional basis. For both the Eastern and Southern Regions, in terms of mean absolute error, the early guidance was as accurate as, or more accurate than, the final guidance for all four projections. In the Central Region, the mean absolute error of the early guidance was less than that of the final guidance at all projections but the last. Finally, even in the Western Region, the early guidance was as accurate as the final for the 36- and 48-h projections. For the remaining two projections, the differences between the early and final guidance were small. This contrasts sharply with the 1977-78 cool season (Gilhousen et al., 1979) when the early guidance in the Western Region was quite inferior to the final guidance at all projections. Finally, both sets of objective guidance had a warm bias in the Western Region at all projections.

The accuracy of the local forecasts relative to the objective guidance also varied from region to region. In the Eastern and Southern Regions, there were only small differences in mean absolute error between the early guidance

However, on a regional basis, the results showed the Western Region forecasters were able to improve on the guidance in many cases. Trends show that the MAE for direction has improved steadily, while MAE for speed jumped in the 1975-76 cool season due to the use of the inflation procedure. This technique, however, did produce better bias characteristics for the guidance. Five-category wind speed results show that the skill of the local forecasts was approximately equal to the skill of the final guidance. In contrast, the early guidance was considerably better than the local forecasts. We note a decline in the skill of both the two-category and five-category during the past two cool seasons. However, overall, the skill of the guidance still exceeded that of the locals.

The various performance measures show that both the early and final opaque sky cover guidance forecasts were more accurate than the local forecasts. Early and final guidance performed equally well at the 3 projections examined. The bias characteristics of the guidance were better than the local forecasts which tended to overforecast scattered and broken conditions. The trend showed an improvement in the guidance at both the 18- and 42-h projections.

A direct comparison between local, MOS guidance, and persistence forecasts for ceiling and visibility was possible only at the 12-h projection. At this projection, the local forecasts were more skillful than the guidance, but in both the two- and six-category comparison, persistence was more skillful than the local forecasts. The long term trend generally shows a disappointing decrease of skill in forecasting low conditions for both early and final guidance, especially pronounced at the 36- and 48-h projections. The bias characteristics of the guidance continued to be generally better than those of the locals in the lower categories where the local forecasts underforecast the occurrence of these events.

Finally, for max/min temperature, new early guidance equations were implemented during the 1978-79 cool season. As a result, the early max/min guidance was more accurate than the final at the first three projections. For the 60-h min forecast, however, the final guidance had lower mean absolute errors. These trends were generally evident in the four NWS regions discussed in this report. Though comparisons between the objective guidance and the local forecasts of the max/min are difficult to make because of the different forecast periods involved, we found that the local forecasts of the max valid approximately 24- and 48-h after 0000 GMT were slightly more accurate in mean absolute error than the objective guidance. The min is particularly difficult to predict during the cool season, and in fact, there was little or no difference in mean absolute error between the guidance and local forecasts for the 36- and 60-h min.

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Table 2.2 Comparative verification of early and final guidance and local PoP forecasts for 87 stations, 0000 GMT cycle.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0916		43.3	13906
	Local	.0879	4.0	45.7	
24-36 h (2nd period)	Early	.1069		36.3	13953
	Final	.1158		31.0	
	Local	.1093	-0.2^{1} (5.6)	34.8	
36-48 h (3rd period)	Early	.1146		29.6	14038
	Final	.1217		25.3	
	Local	.1147	0.0^{1} (5.8)	29.6	

[1] This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 2.4 Same as Table 2.2 except for 23 stations in the Southern Region.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0863	7.8	38.8	3699
	Local	.0796		43.6	
24-36 h (2nd period)	Early	.1045		31.3	3708
	Final	.1136		24.9	
	Local	.1085	-3.8[1] (4.5)	28.3	
36-48 h (3rd period)	Early	.1059		25.6	3727
	Final	.1157		18.8	
	Local	.1091	-3.0[1] (5.7)	23.4	

1 This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 2.6 Same as Table 2.2 except for 16 stations in the Western Region.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0973		39.0	2537
	Local	.0894	8.1	43.9	
24-36 h (2nd period)	Early	.1010		32.5	2544
	Final	.1022		31.5	
	Local	.0977	3.3[1] (4.4)	34.5	
36-48 h (3rd period)	Early	.1168		25.1	2574
	Final	.1131		27.6	
	Local	.1101	5.7[1] (2.7)	29.5	

[1] This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 3.2. Comparative verification of early PoPT guidance and local forecasts by NWS Region, 0000 GMT cycle. Only cases when local PoP was ≥ 30% are included.

Projection (h)	Region	Type of Fcst.	Bias Snow	Bias Freezing Rain	Bias Rain	Percent Correct	Skill Score	Number of Cases
18	Eastern	Early Local	1.07 1.03	-- --	.94 .97	91 90	.82 .81	373
	Southern	Early Local	.72 .60	-- --	1.03 1.04	94 93	.78 .73	164
	Central	Early Local	1.04 1.03	-- --	.98 .93	89 85	.77 .70	255
	Western	Early Local	.95 .90	-- --	1.04 1.11	91 90	.83 .79	162
	All Stations	Early Local	1.02 .98	1.00 1.38	.99 1.00	91 89	.82 .79	954
30	Eastern	Early Local	1.08 1.05	-- --	.94 .99	85 86	.74 .73	349
	Southern	Early Local	1.08 1.23	-- --	1.00 .98	89 88	.50 .51	155
	Central	Early Local	1.03 1.11	-- --	.89 .86	86 84	.73 .68	282
	Western	Early Local	1.04 1.09	-- --	.98 .96	91 87	.82 .74	148
	All Stations	Early Local	1.05 1.09	1.11 .68	.95 .96	87 86	.76 .74	934
42	Eastern	Early Local	1.11 1.11	-- --	.84 .93	83 86	.68 .72	353
	Southern	Early Local	.94 .65	-- --	1.02 1.05	92 87	.67 .44	135
	Central	Early Local	1.10 1.06	-- --	.85 .98	85 85	.69 .69	240
	Western	Early Local	1.13 1.08	-- --	.93 .98	89 90	.77 .79	139
	All Stations	Early Local	1.10 1.06	1.50 .55	.90 .98	86 86	.73 .73	867

Table 3.4 Comparative verification of early PoPT guidance, final PoF guidance, and local forecasts by NWS Region, 0000 GMT cycle. Only cases when local PoP was ≥ 30% were included.

Projection (h)	Region	Type of Fcst.	Bias Snow	Bias Rain	Percent Correct	Skill Score	Number of Cases
18	Eastern	Early	1.07	.95	93	.86	373
		Final	1.14	.90	92	.84	
		Local	1.03	.98	91	.83	
	Southern	Early	.72	1.05	96	.81	164
		Final	.80	1.04	91	.61	
		Local	.60	1.07	94	.72	
	Central	Early	1.04	.93	91	.81	255
		Final	1.12	.80	89	.75	
		Local	1.03	.95	88	.74	
	Western	Early	.95	1.05	93	.85	162
		Final	1.04	.96	92	.84	
		Local	.90	1.09	90	.80	
	All Stations	Early	1.02	.99	93	.86	954
		Final	1.09	.93	91	.82	
		Local	.98	1.02	91	.81	
30	Eastern	Early	1.08	.94	89	.78	349
		Final	1.11	.92	89	.77	
		Local	1.05	.97	88	.76	
	Southern	Early	1.00	1.00	95	.66	155
		Final	1.08	.99	94	.64	
		Local	1.23	.98	94	.66	
	Central	Early	1.03	.96	88	.74	282
		Final	1.11	.84	89	.76	
		Local	1.11	.83	86	.71	
	Western	Early	1.04	.98	92	.83	148
		Final	.96	1.02	88	.74	
		Local	1.09	.95	87	.73	
	All Stations	Early	1.05	.96	90	.79	934
		Final	1.09	.94	89	.78	
		Local	1.09	.94	88	.76	
42	Eastern	Early	1.11	.92	88	.77	353
		Final	1.24	.83	87	.74	
		Local	1.11	.92	88	.75	
	Southern	Early	.94	1.01	95	.76	135
		Final	.82	1.03	93	.67	
		Local	.65	1.05	91	.52	
	Central	Early	1.10	.84	87	.72	240
		Final	1.20	.70	87	.72	
		Local	1.06	.92	86	.70	
	Western	Early	1.13	.92	91	.81	139
		Final	1.11	.93	91	.82	
		Local	1.08	.95	91	.82	
	All Stations	Early	1.10	.92	89	.79	867
		Final	1.19	.87	89	.77	
		Local	1.06	.96	88	.76	

Table 4.2. Comparative verification of early and final guidance and local surface wind forecasts for 94 stations, 0000 GMT cycle.

		DIRECTION		SPEED													
								CONTINGENCY TABLE									
										BIAS-NO. FCST/NO. OBS							
FCST PROJ (HOURS)	TYPE OF FCST	MEAN ABS ERROR (DEG)	NO. OF CASES	MEAN ABS ERROR (KTS)	MEAN FCST (KTS)	MEAN OBS (KTS)	NO. OF CASES	SKILL SCORE	PERCENT FCST CORRECT	CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
	EARLY	24		3.2	12.6			0.32	55	1.20	0.96	0.80	0.60	0.59	0.70	0.20	
18	FINAL	26	5542	3.4	12.7	12.9	5584	0.30	54	1.18	0.97	0.83	0.60	0.55	0.65	0.20	13403
	LOCAL	28		3.5	13.7			0.30	51	0.80 (5340)	1.19 (4635)	1.18 (2412)	0.80 (811)	0.65 (172)	1.00 (23)	0.70 (10)	
	EARLY	30		3.6	12.1			0.38	63	1.06	1.00	0.85	0.50	0.47	0.0	0.0	
30	FINAL	33	3160	3.8	12.1	11.6	3198	0.31	62	1.10	0.91	0.78	0.63	0.49	0.38	0.50	13070
	LOCAL	36		3.9	12.7			0.27	57	0.90 (7623)	1.26 (3610)	0.99 (1387)	0.69 (375)	0.60 (57)	0.56 (16)	1.00 (2)	
	EARLY	33		3.9	13.4			0.25	49	1.04	1.02	0.96	0.82	0.75	0.89	0.50	
42	FINAL	37	5040	4.0	12.7	12.4	5095	0.21	47	1.20	0.97	0.74	0.71	0.60	0.79	0.17	12980
	LOCAL	41		4.0	13.0			0.20	46	0.87 (5135)	1.27 (4513)	0.97 (2372)	0.57 (776)	0.34 (159)	0.42 (19)	0.50 (6)	

Table 4.4. Same as Table 4.2 except for 24 stations in the Eastern Region.

FCST PROJ (HOURS)	TYPE OF FCST	DIRECTION MEAN ABS ERROR (DEG)	DIRECTION NO. OF CASES	SPEED MEAN ABS ERROR (KTS)	SPEED MEAN FCST (KTS)	SPEED MEAN OBS (KTS)	SPEED NO. OF CASES	SKILL SCORE	PERCENT FCST CORRECT	CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
								CONTINGENCY TABLE		BIAS-NO. FCST/NO. OBS							
	EARLY	25		3.1	13.0			0.31	53	1.19	0.96	0.84	0.78	0.91	0.40	*	
18	FINAL	26	1576	3.1	12.8	13.0	1582	0.30	52	1.27	0.92	0.85	0.68	0.56	0.60	*	3267
	LOCAL	29		3.5	14.1			0.27	49	0.80 (1097)	1.07 (1243)	1.24 (658)	0.84 (219)	1.11 (45)	1.60 (5)	*** (0)	
	EARLY	29		3.3	12.3			0.37	64	1.10	0.94	0.88	0.54	0.19	0.0	*	
30	FINAL	31	919	3.7	12.5	11.9	929	0.32	61	1.11	0.90	0.82	0.71	0.56	3.00	*	3222
	LOCAL	35		4.0	13.6			0.30	57	0.88 (1803)	1.18 (894)	1.14 (392)	0.98 (114)	1.31 (16)	6.00 (1)	** (0)	
	EARLY	31		3.7	13.7			0.26	49	1.16	0.92	0.94	0.88	0.83	1.00	*	
42	FINAL	33	1407	3.9	13.0	12.7	1420	0.18	44	1.34	0.88	0.78	0.78	0.54	1.00	**	3215
	LOCAL	39		4.1	13.7			0.19	43	0.88 (1065)	1.10 (1222)	1.09 (657)	0.81 (226)	0.61 (41)	1.25 (4)	*** (0)	

* This category was neither forecast nor observed.
** This category was forecast once but was never observed.
*** This category was forecast twice but was never observed.

Table 4.6. Same as Table 4.2 except for 28 stations in the Central Region.

FCST PROJ (HOURS)	TYPE OF FCST	DIRECTION: MEAN ABS ERROR (DEG)	DIRECTION: NO. OF CASES	SPEED: MEAN ABS ERROR (KTS)	SPEED: MEAN FCST (KTS)	SPEED: MEAN OBS (KTS)	SPEED: NO. OF CASES	CONTINGENCY TABLE: SKILL SCORE	CONTINGENCY TABLE: PERCENT FCST CORRECT	BIAS-NO. FCST/NO. OBS: CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
	EARLY	21		3.2	12.7			0.31	52	1.21	1.03	0.86	0.58	0.52	0.50	0.14	
18	FINAL	23	2187	3.4	12.8	13.1	2209	0.28	49	1.10	1.09	0.91	0.58	0.55	0.60	0.14	4067
	LOCAL	26		3.4	13.8			0.24	47	0.63 (1229)	1.22 (1508)	1.22 (925)	0.85 (317)	0.62 (71)	0.70 (10)	0.29 (7)	
	EARLY	27		3.6	12.3			0.30	57	1.11	0.96	0.85	0.60	0.71	0.0	*	
30	FINAL	31	1249	3.8	12.2	11.7	1265	0.28	56	1.11	0.95	0.84	0.67	0.43	0.30	*	3991
	LOCAL	34		3.9	12.5			0.21	49	0.81 (1954)	1.33 (1318)	1.01 (538)	0.60 (150)	0.38 (21)	0.10 (10)	** (0)	
	EARLY	29		3.9	13.4			0.23	46	1.14	0.99	0.91	0.86	0.62	1.29	0.50	
42	FINAL	33	1911	4.1	13.0	12.8	1927	0.18	42	1.25	1.01	0.73	0.85	0.68	1.00	0.00	3967
	LOCAL	38		4.0	12.9			0.15	42	0.74 (1198)	1.36 (1498)	0.95 (907)	0.57 (291)	0.31 (71)	0.14 (7)	0.00 (4)	

* This category was neither forecast nor observed.

** This category was forecast once but was never observed.

Table 4.8. Distribution of absolute errors associated with early and final guidance and local forecasts of surface wind direction for 94 stations, 0000 GMT cycle.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
	EARLY	79.6	13.6	3.4	1.6	1.1	0.7
18	FINAL	77.0	15.3	3.7	1.8	1.4	0.8
	LOCAL	73.7	17.1	4.3	2.1	1.8	1.0
	EARLY	72.9	16.6	4.6	2.6	1.6	1.7
30	FINAL	69.2	17.4	6.0	3.1	2.4	1.9
	LOCAL	65.2	18.9	7.6	3.8	2.4	2.1
	EARLY	69.2	17.3	5.7	3.4	2.4	2.0
42	FINAL	64.2	18.8	8.0	4.3	2.6	2.1
	LOCAL	57.3	22.6	9.3	4.7	3.5	2.6

Table 4.10. Same as Table 4.8 except for 24 stations in the Southern Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	EARLY	78.0	14.9	3.4	1.7	1.2	0.8
	FINAL	75.3	15.9	4.8	1.8	1.4	0.8
	LOCAL	73.4	17.3	4.2	2.4	1.8	0.9
30	EARLY	69.0	17.3	5.8	3.7	2.0	2.2
	FINAL	67.0	16.5	5.6	4.8	3.0	3.1
	LOCAL	62.1	19.7	7.8	4.1	3.4	2.9
42	EARLY	66.0	18.8	6.5	3.6	3.4	1.7
	FINAL	57.9	20.6	10.2	5.3	3.5	2.5
	LOCAL	50.1	26.7	10.4	5.8	3.8	3.2

Table 4.12. Same as Table 4.8 except for 18 stations in the Western Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	EARLY	66.5	16.7	7.3	4.2	2.9	2.4
	FINAL	68.0	17.2	4.6	3.9	4.1	2.2
	LOCAL	68.9	15.3	3.6	3.2	5.1	3.9
30	EARLY	66.1	16.3	6.7	4.2	3.9	2.8
	FINAL	68.9	12.4	7.8	4.6	2.5	3.9
	LOCAL	64.0	13.4	9.2	6.4	2.5	4.5
42	EARLY	54.4	19.8	9.0	6.4	5.4	5.0
	FINAL	51.3	20.8	10.4	7.6	5.7	5.2
	LOCAL	53.2	18.9	7.8	6.4	7.1	6.6

Table 5.2 Comparative verification of early and final guidance and local forecasts of four categories of cloud amount (clear, scattered, broken, overcast) for 94 stations, 0000 GMT cycle.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS				PERCENT CORRECT	SKILL SCORE	NO. OF CASES
		CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)			
18	EARLY -LFM	1.09	.83	.97	1.03	55.5	.385	12710
	FINAL -PE	1.09	.82	.96	1.04	55.3	.381	
	LOCAL	.69 (3794)	1.46 (2380)	1.35 (2136)	.85 (4400)	52.2	.360	
30	EARLY	1.13	.82	.75	1.00	59.8	.383	12337
	FINAL	1.00	.77	.80	1.14	58.7	.383	
	LOCAL	.67 (4802)	1.98 (1613)	1.80 (1345)	.77 (4577)	49.5	.315	
42	EARLY	1.17	.82	.93	.99	49.6	.303	12339
	FINAL	.97	.74	1.11	1.12	49.7	.304	
	LOCAL	.57 (3678)	1.75 (2332)	1.52 (2048)	.71 (4281)	41.1	.225	

Table 5.4 Same as Table 5.2 except for 24 stations in the Southern Region.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS				PERCENT CORRECT	SKILL SCORE	NO. OF CASES
		CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)			
18	EARLY	1.08	.95	.91	1.00	57.6	.414	3275
	FINAL	1.09	.92	.91	1.00	56.2	.393	
	LOCAL	.77 (1102)	1.54 (626)	1.36 (527)	.73 (1020)	53.0	.374	
30	EARLY	1.13	1.10	.53	.93	60.2	.395	3230
	FINAL	1.08	.96	.57	1.04	60.3	.395	
	LOCAL	.79 (1427)	1.94 (421)	1.73 (335)	.68 (1047)	52.1	.338	
42	EARLY	1.20	.93	.72	.97	51.4	.323	3163
	FINAL	1.07	.79	.99	1.07	51.0	.322	
	LOCAL	.69 (1060)	1.86 (621)	1.53 (505)	.51 (977)	39.4	.205	

Table 5.6 Same as Table 5.2 except for 18 stations in the Western Region.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS				PERCENT CORRECT	SKILL SCORE	NO. OF CASES
		CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)			
18	EARLY	1.16	.86	.90	.97	51.9	.337	2449
	FINAL	1.15	.83	.98	.96	52.1	.341	
	LOCAL	.80 (809)	1.20 (469)	1.36 (439)	.87 (732)	51.6	.352	
30	EARLY	1.21	.95	.49	.97	54.6	.330	2346
	FINAL	1.13	.91	.48	1.11	55.1	.340	
	LOCAL	.69 (954)	1.81 (346)	1.65 (326)	.73 (720)	46.7	.285	
42	EARLY	1.30	.69	.85	.94	47.1	.262	2373
	FINAL	1.15	.76	.92	1.03	46.7	.262	
	LOCAL	.72 (797)	1.57 (446)	1.45 (422)	.69 (708)	39.8	.204	

Table 6.2 Comparative verification of early and final guidance, persistence, and local ceiling forecasts for 94 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	5	6	Percent Correct	Heidke Skill Score
12	Early	.71	.99	1.01	1.03	1.04	.99	62.7	.390
	Final	.75	.97	1.04	1.05	1.02	.99	66.1	.446
	Local	.55	.94	.85	1.17	1.07	.98	73.0	.560
	Persistence	.89	.89	.83	1.00	.99	1.03	75.6	.593
	No. Obs.	294	548	900	1943	1712	7705		
15	Local	.32	.58	.79	1.20	1.16	.99	66.4	.443
	Persistence	1.17	.81	.84	.97	1.02	1.03	66.4	.435
	No. Obs.	222	666	892	2017	1687	7949		
18	Early	.52	.98	1.00	1.07	1.05	.98	63.4	.375
	Final	.48	.89	1.03	1.08	1.06	.97	63.8	.383
	Persistence	2.73	1.17	.92	.91	1.08	.98	61.7	.347
	No. Obs.	102	481	833	2191	1651	8275		
21	Local	.18	.33	.70	1.21	1.25	.96	65.1	.376
	Persistence	4.34	1.44	1.10	1.02	.96	.95	59.3	.285
	No. Obs.	62	380	683	1917	1816	8587		
24	Early	.38	1.05	.84	1.12	.97	1.00	65.7	.374
	Final	.47	.97	.95	1.18	1.02	.97	64.6	.365
	Persistence	2.60	1.42	1.20	1.14	.90	.94	56.4	.239
	No. Obs.	107	397	640	1752	1980	8680		
36	Early	.35	.94	.79	1.11	1.04	1.02	57.4	.299
	Final	.69	1.16	.92	1.42	1.10	.88	54.4	.293
	Persistence	.94	.93	.82	.98	.99	1.04	48.5	.148
	No. Obs.	297	604	935	2035	1801	7866		
48	Early	.23	.95	.82	1.05	.94	1.03	61.8	.285
	Final	.24	.91	.87	1.19	1.15	.95	60.3	.291
	Persistence	2.93	1.44	1.19	1.15	.91	.94	47.9	.087
	No. Obs.	95	360	643	1738	1956	8713		

Table 6.4 Same as Table 6.2 except for 1200 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	5	6	Percent Correct	Heidke Skill Score
12	Early	.62	.93	.96	1.06	.98	1.00	67.7	.405
	Final	.64	.94	.98	1.00	.99	1.01	70.1	.448
	Local	.30	.85	.91	1.26	.96	.98	76.5	.575
	Persistence	.68	.96	1.05	1.13	.94	.99	76.7	.576
	No. Obs.	98	373	612	1694	1952	8510		
15	Local	.23	.79	.96	1.26	.94	.99	70.6	.471
	Persistence	.56	.88	.98	1.11	.96	1.00	68.7	.433
	No. Obs.	124	413	653	1721	1905	8477		
18	Early	.76	.95	.99	1.01	1.04	1.01	63.6	.368
	Final	1.11	1.07	.91	.97	1.00	1.01	64.8	.385
	Persistence	.38	.76	.92	1.03	1.00	1.03	63.1	.347
	No. Obs.	190	491	736	1905	1894	8421		
21	Local	.21	.78	1.01	1.24	.95	.99	63.6	.385
	Persistence	.28	.69	.83	.98	1.03	1.06	59.1	.285
	No. Obs.	241	526	768	1925	1774	7945		
24	Early	.59	1.06	1.01	1.04	1.06	.98	59.4	.341
	Final	.66	1.23	.93	1.02	1.12	.97	60.0	.356
	Persistence	.24	.61	.71	.97	1.04	1.09	55.5	.240
	No. Obs.	304	609	949	2036	1813	7971		
36	Early	.34	1.17	.95	1.00	.93	1.02	63.2	.318
	Final	.33	1.17	1.07	1.12	1.13	.94	61.7	.322
	Persistence	.76	.90	1.04	1.13	.96	.99	52.4	.133
	No. Obs.	98	415	648	1747	1969	8803		
48	Early	.43	1.01	.92	.90	1.09	1.04	56.0	.271
	Final	.52	1.10	1.06	1.00	1.28	.94	54.3	.273
	Persistence	.24	.60	.71	.97	1.05	1.09	47.2	.098
	No. Obs.	304	627	944	2023	1810	7973		

Table 6.6 Comparative verification of early and final guidance, persistance and local ceiling forecasts for 94 stations, 0000 GMT cycle. Scores are computed from two-category contingency tables.

Projection	Type of Forecast	Rel Freq Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Heidke Skill Score	Threat Score
12	Early Final Local Persistence	.068	.899 .900 .815 .892	91.6 93.1 95.1 95.4	.300 .426 .580 .619	.208 .301 .434 .474
15	Local Persistence	.066	.516 .902	93.9 93.4	.364 .443	.244 .314
18	Early Final Persistence	.043	.899 .820 1.44	94.2 94.7 92.7	.266 .291 .272	.174 .189 .183
21	Local Persistence	.033	.308 1.851	96.4 92.6	.157 .178	.093 .119
24	Early Final Persistence	.037	.908 .865 1.668	94.9 94.7 92.2	.256 .215 .173	.165 .138 .173
36	Early Final Persistence	.067	.746 1.002 .933	91.1 90.0 89.6	.188 .198 .133	.132 .144 .104
48	Early Final Persistence	.036	.806 .777 1.734	94.9 94.8 91.1	.179 .164 .050	.115 .105 .049

Table 6.8 Same as Table 6.6 except for 1200 GMT cycle.

Projection	Type of Forecast	Rel Freq Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Heidke Skill Score	Threat Score
12	Early Final Local Persistence	.036	.864 .879 .738 .900	95.4 96.3 97.2 97.3	.285 .432 .537 .589	.182 .291 .380 .431
15	Local Persistence	.040	.663 .806	96.3 95.9	.432 .416	.290 .280
18	Early Final Persistence	.050	1.246 1.082 .653	93.3 93.2 94.3	.260 .305 .279	.173 .206 .182
21	Local Persistence	.058	.604 .558	93.7 93.2	.289 .222	.191 .146
24	Early Final Persistence	.067	.904 1.043 .431	91.0 90.5 91.7	.244 .255 .131	.171 .180 .092
36	Early Final Persistence	.038	1.014 1.007 .873	94.3 94.2 93.6	.212 .203 .063	.138 .132 .050
48	Early Final Persistence	.068	.823 .914 .481	90.3 90.1 90.8	.168 .186 .042	.123 .136 .044

Table 6.10 Heidke skill score for ceiling categories 1 and 2 combined for the comparative verification of early and final guidance, peristence, and local forecasts for 94 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Year			
		1975/76	1976/77	1977/78	1978/79
12	Early		.317	.352	.300
	Final	.368	.226	.431	.426
	Local	.540	.452	.566	.580
	Persistence	.607	.529	.607	.619
	No. Cases	13915	4199	14030	13152
15	Local	.320		.363	.364
	Persistence	.242		.421	.443
	No. Cases	14984		14993	13433
18	Early		.190	.224	.266
	Final	.144	.246	.216	.291
	Persistence	.239	.123	.262	.272
	No. Cases	14009	4227	14202	13533
21	Local	.166	.053	.121	.157
	Persistence	.167	.086	.176	.178
	No. Cases	14979	4279	14983	13445
24	Early		.166	.182	.252
	Final	.043	.144	.188	.215
	Persistence	.131	.050	.149	.173
	No. Cases	14052	4224	14203	13536
36	Early			.215	.188
	Final		.187	.235	.198
	Persistence		.054	.127	.133
	No. Cases		4227	4971	13538
48	Early			.202	.179
	Final		.132	.195	.164
	Persistence		.036	.099	.050
	No. Cases		4224	4973	13535

Table 6.12 Same as Table 6.10 except for the 1200 GMT cycle.

Projection (h)	Type of Forecast	Year 1975/76	1976/77	1977/78	1978/79
12	Early		.157	.277	.285
	Final	.301	.251	.351	.432
	Local	.472	.420	.487	.537
	Persistence	.520	.387	.576	.431
	No. Cases	13486	4217	14228	13238
15	Local	.387	.343	.390	.432
	Persistence	.344	.249	.423	.416
	No. Cases	14779	3232	14675	13293
18	Early		.215	.250	.260
	Final	.149	.272	.288	.305
	Persistence	.274	.215	.353	.279
	No. Cases	13632	4269	14454	13637
21	Local	.237	.270	.306	.289
	Persistence	.195	.143	.229	.222
	No. Cases	14786	4216	14672	13179
24	Early		.272	.232	.244
	Final	.100	.253	.298	.255
	Persistence	.126	.106	.176	.131
	No. Cases	13723	4269	14452	13682
36	Early			.212	.212
	Final		.064	.215	.203
	Persistence		-.002	.054	.063
	No. Cases		4266	5157	13680
48	Early			.204	.168
	Final		.153	.195	.186
	Persistence		.002	.070	.042
	No. Cases		4269	5755	13681

Table 6.14. Bias for ceiling categories 1 and 2 combined for the comparative verification of early and final guidance, persistence, and local forecasts for 94 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Year			
		1975/76	1976/77	1977/78	1978/79
12	Early		.79	.89	.90
	Final	.59	.37	.84	.90
	Local	.76	.67	.88	.82
	Persistence	.82	.81	.81	.89
15	Local	.54		.55	.52
	Persistence	.95		.96	.90
18	Early		1.26	.85	.90
	Final	.20	1.00	.78	.82
	Persistence	1.66	1.73	1.52	1.44
21	Local	.35	.17	.38	.31
	Persistence	2.27	2.22	1.88	1.85
24	Early		1.00	.75	.91
	Final	.10	.73	.75	.87
	Persistence	2.09	1.99	1.72	1.67
36	Early			.59	.75
	Final		.89	.72	1.00
	Persistence		.80	.97	.93
48	Early			.66	.81
	Final		1.16	.71	.78
	Persistence		1.77	2.06	1.73

Table 6.16. Same as Table 6.14 except for the 1200 GMT cycle.

Projection (h)	Type of Forecast	Year			
		1975/76	1976/77	1977/78	1978/79
12	Early		1.00	.77	.86
	Final	.66	.91	.83	.88
	Local	.69	.67	.90	.74
	Persistence	.91	.94	.73	.90
15	Local	.62	.59	.68	.66
	Persistence	.73	.74	.78	.81
18	Early		1.24	.86	1.25
	Final	.28	1.06	1.04	1.08
	Persistence	.60	.63	.65	.65
21	Local	.50	.54	.60	.60
	Persistence	.45	.51	.52	.56
24	Early		.77	.86	.90
	Final	.17	.84	.96	1.04
	Persistence	.36	.39	.46	.43
36	Early			1.06	1.01
	Final		1.57	.72	1.01
	Persistence		.89	.92	.87
48	Early			.58	.82
	Final		.92	.60	.91
	Persistence		.39	.47	.48

Table 7.1. Comparative verification of early and final guidance and local max/min temperature forecasts for 87 stations, 0000 GMT cycle.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR (°F)	MEAN ABSOLUTE ERROR (°F)	NUMBER (%) OF ABSOLUTE ERRORS ≥ 10°	NUMBER OF CASES
	EARLY	0.0	3.5	636 (4.3)	
24 (MAX)	FINAL	-0.3	3.7	778 (5.3)	14770
	LOCAL	-0.4	3.4	595 (4.0)	
	EARLY	0.4	4.5	1442 (9.7)	
36 (MIN)	FINAL	0.4	4.6	1560 (10.5)	14811
	LOCAL	1.2	4.5	1534 (10.4)	
	EARLY	0.0	4.6	1611 (10.9)	
48 (MAX)	FINAL	-0.2	5.0	1917 (13.0)	14765
	LOCAL	-0.5	4.5	1525 (10.3)	
	EARLY	0.5	5.5	2495 (16.8)	
60 (MIN)	FINAL	0.6	5.4	2368 (15.9)	14886
	LOCAL	1.0	5.4	2429 (16.3)	

Table 7.3. Same as Table 7.1 except for 23 stations in the Southern Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR (^{o}F)	MEAN ABSOLUTE ERROR (^{o}F)	NUMBER (%) OF ABSOLUTE ERRORS $\geq 10^{o}$	NUMBER OF CASES
24 (MAX)	EARLY	0.2	3.5	176 (4.5)	3894
	FINAL	-0.3	3.8	221 (5.7)	
	LOCAL	-0.2	3.4	159 (4.1)	
36 (MIN)	EARLY	0.2	4.3	333 (8.5)	3902
	FINAL	0.1	4.4	343 (8.8)	
	LOCAL	0.7	4.3	335 (8.6)	
48 (MAX)	EARLY	-0.3	4.7	452 (11.6)	3900
	FINAL	-0.2	5.2	562 (14.4)	
	LOCAL	-0.3	4.5	444 (11.4)	
60 (MIN)	EARLY	-0.1	5.1	592 (15.1)	3921
	FINAL	0.0	5.1	555 (14.2)	
	LOCAL	0.4	5.3	593 (15.1)	

Table 7.5. Same as Table 7.1 except for 16 stations in the Western Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR (°F)	MEAN ABSOLUTE ERROR (°F)	NUMBER (%) OF ABSOLUTE ERRORS ≥ 10°	NUMBER OF CASES
24 (MAX)	EARLY	0.3	3.2	91 (3.4)	2713
	FINAL	0.2	3.1	93 (3.4)	
	LOCAL	0.3	2.9	73 (2.7)	
36 (MIN)	EARLY	1.0	4.0	235 (8.6)	2720
	FINAL	0.6	4.2	243 (8.9)	
	LOCAL	1.0	4.2	242 (8.9)	
48 (MAX)	EARLY	1.0	4.2	215 (7.9)	2707
	FINAL	0.6	4.2	224 (8.3)	
	LOCAL	0.3	4.0	208 (7.7)	
60 (MIN)	EARLY	1.9	5.1	353 (12.9)	2731
	FINAL	0.7	4.9	360 (13.2)	
	LOCAL	1.1	4.9	361 (13.2)	

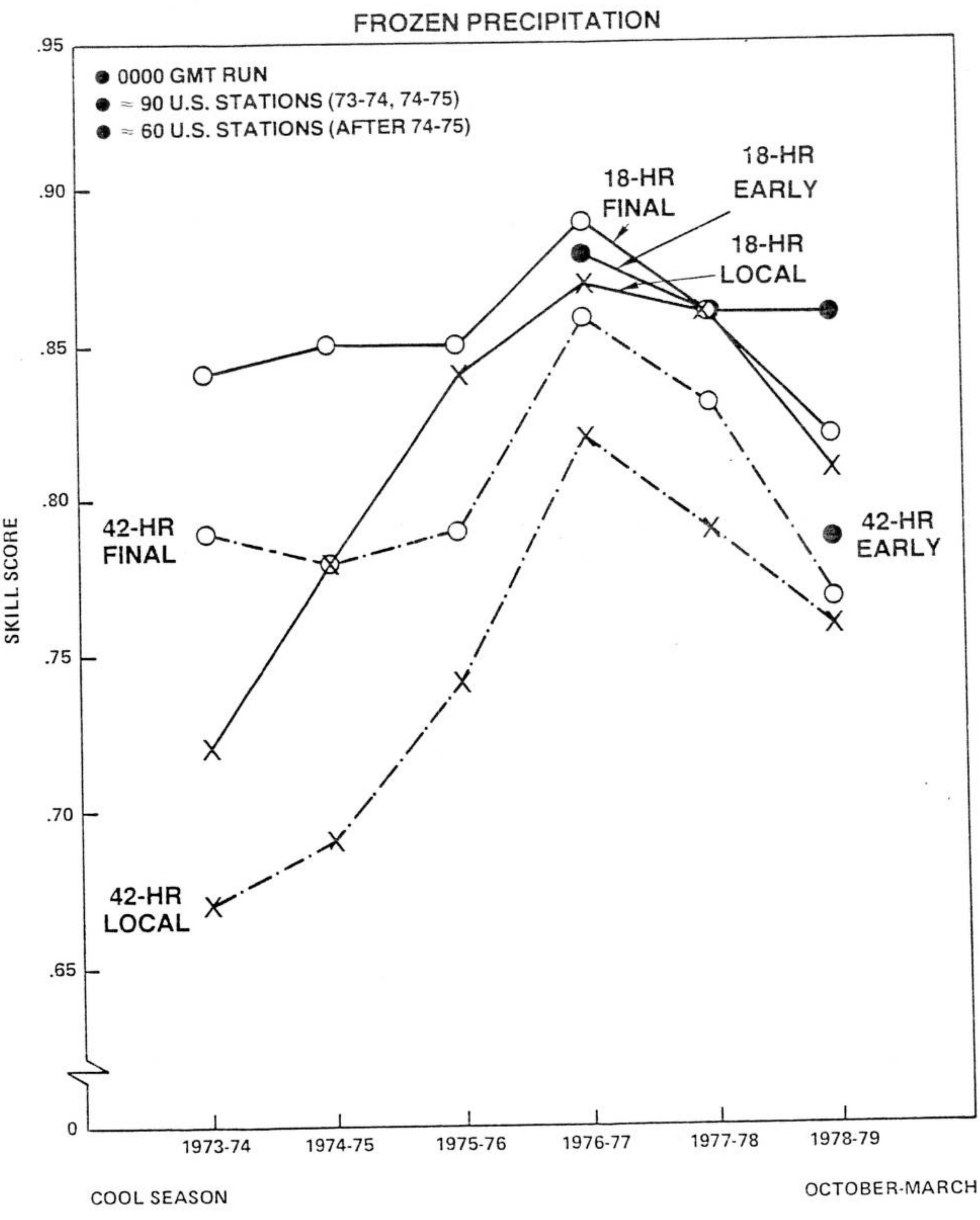

Figure 3.1. The skill scores for guidance and local forecasts of frozen precipitation.

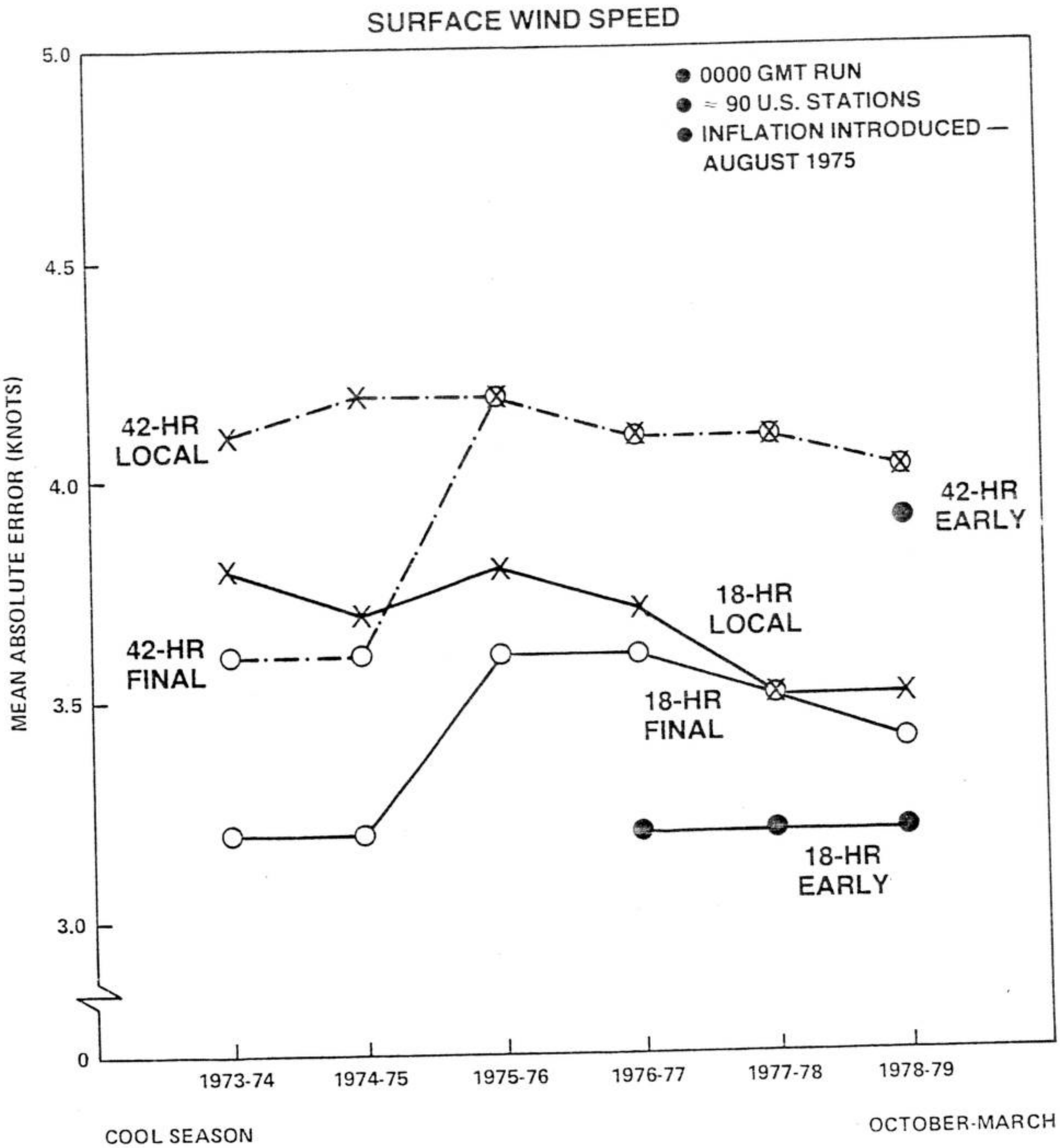

Figure 4.2. Same as Fig. 4.1 except for wind speed forecasts.

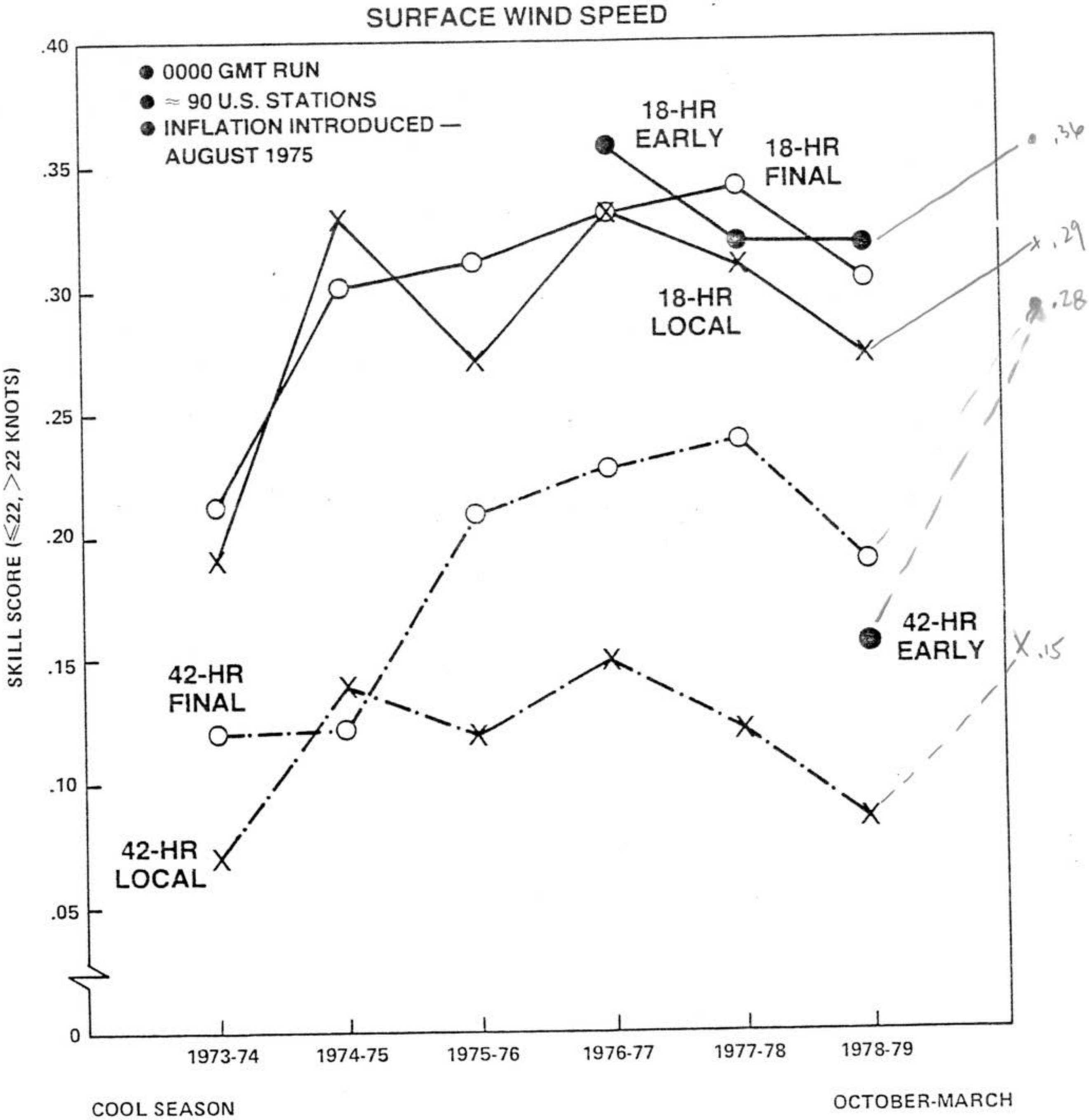

Figure 4.4. Same as Fig. 4.3 except for two-category contingency tables.

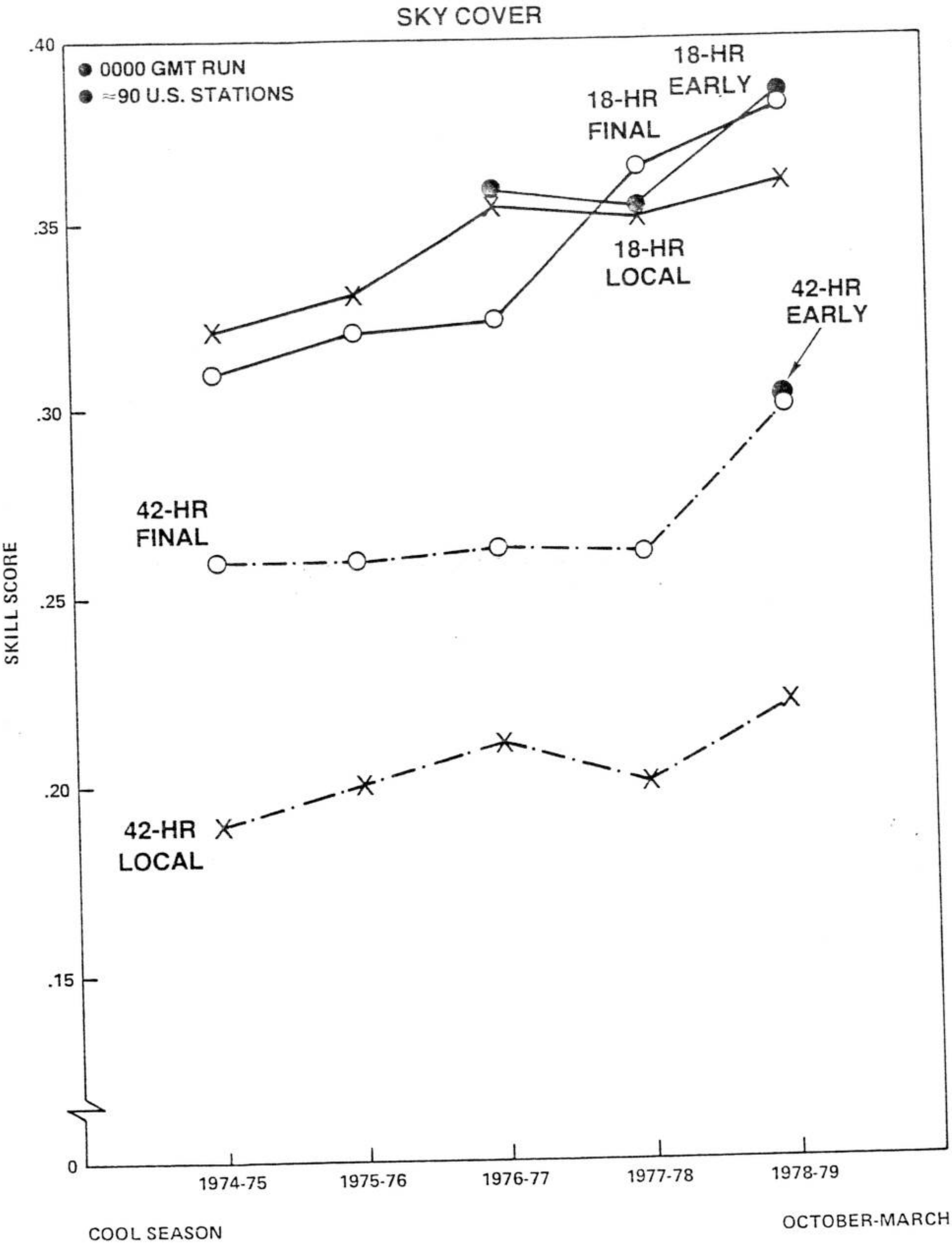

Figure 5.2. Skill score for local and guidance cloud amount forecasts.

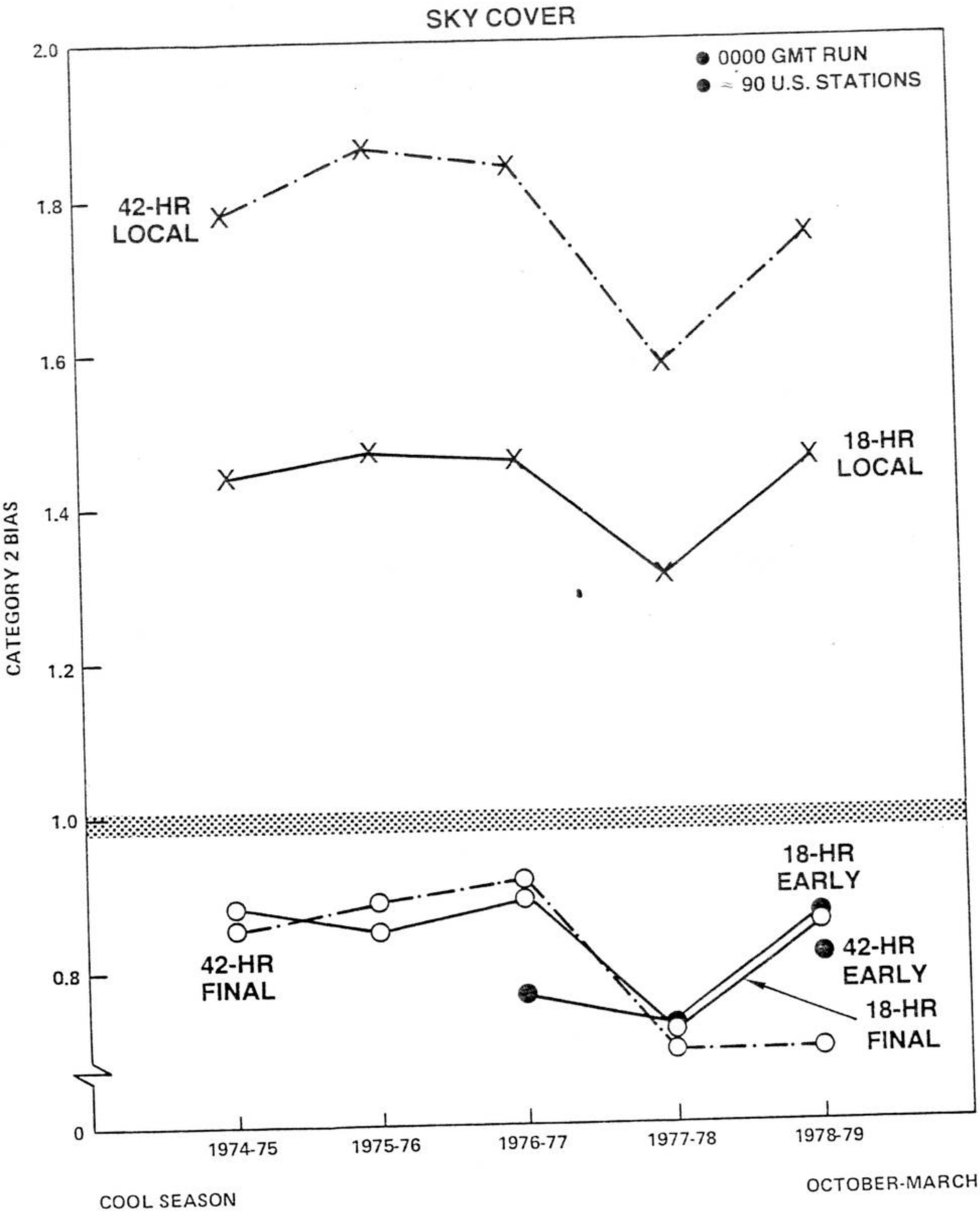

Figure 5.4. Same as Fig. 5.3 except for category 2 bias.

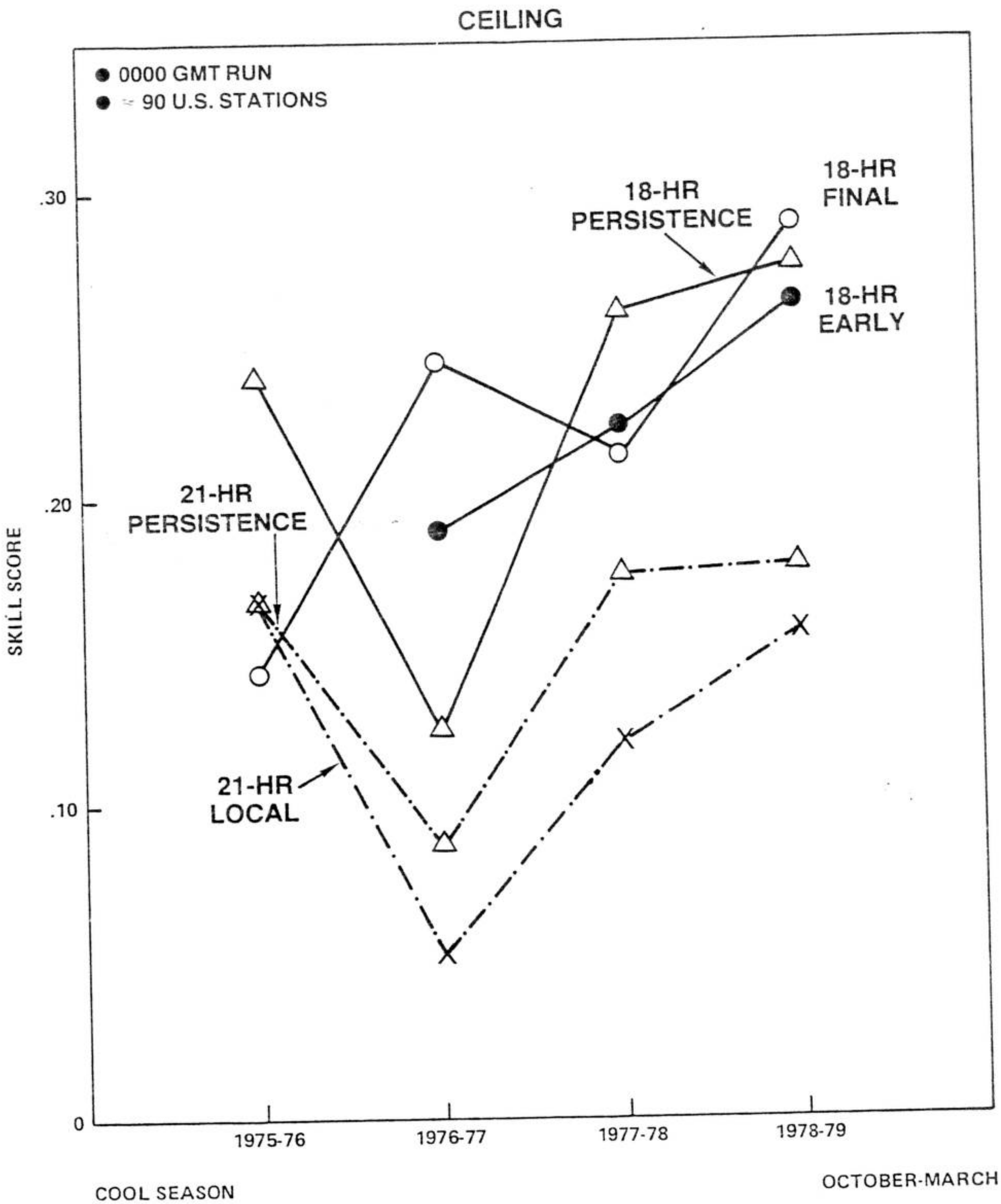

Figure 6.2. Same as Fig. 6.1.

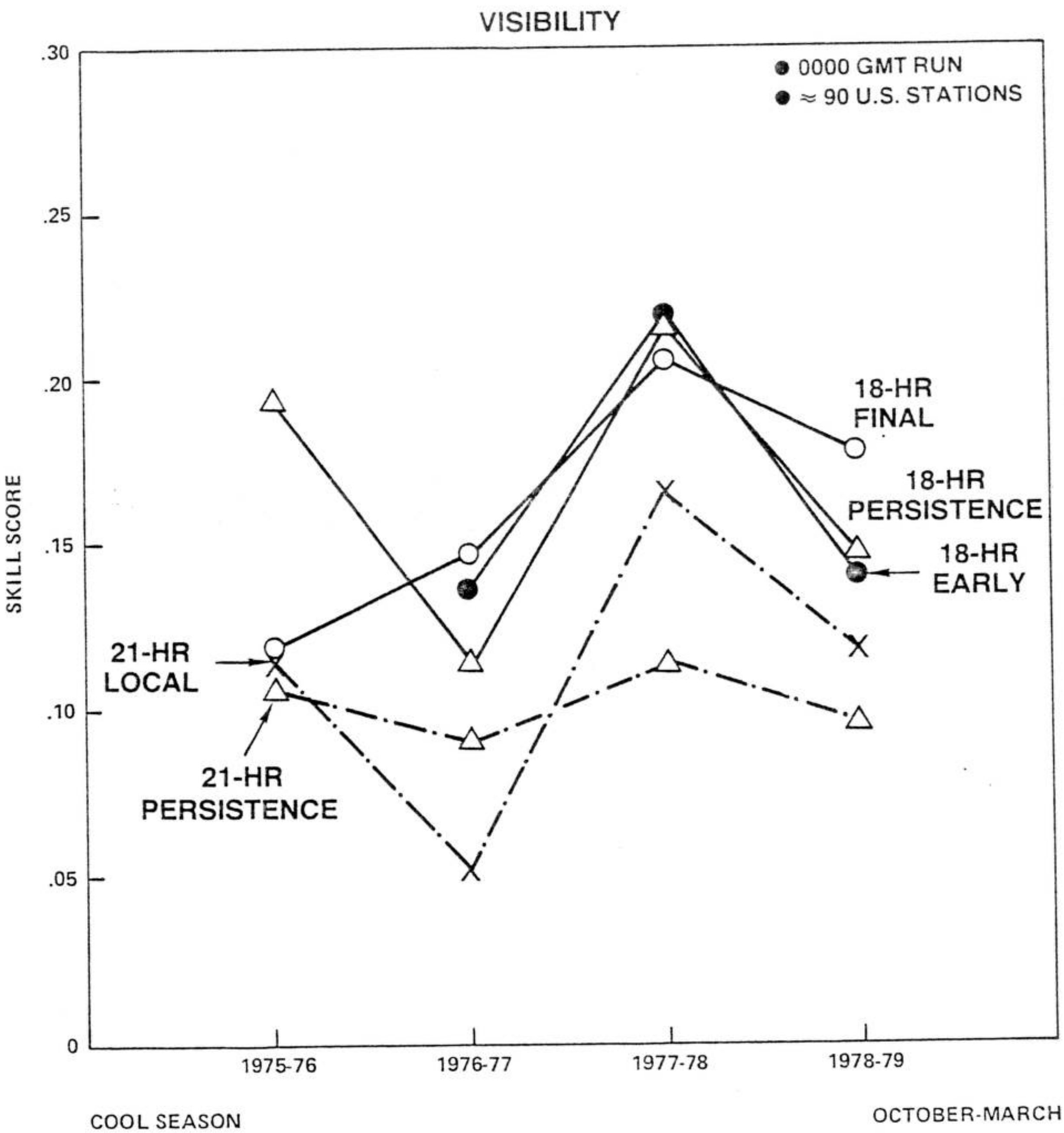

Figure 6.4. Same as Fig. 6.3.

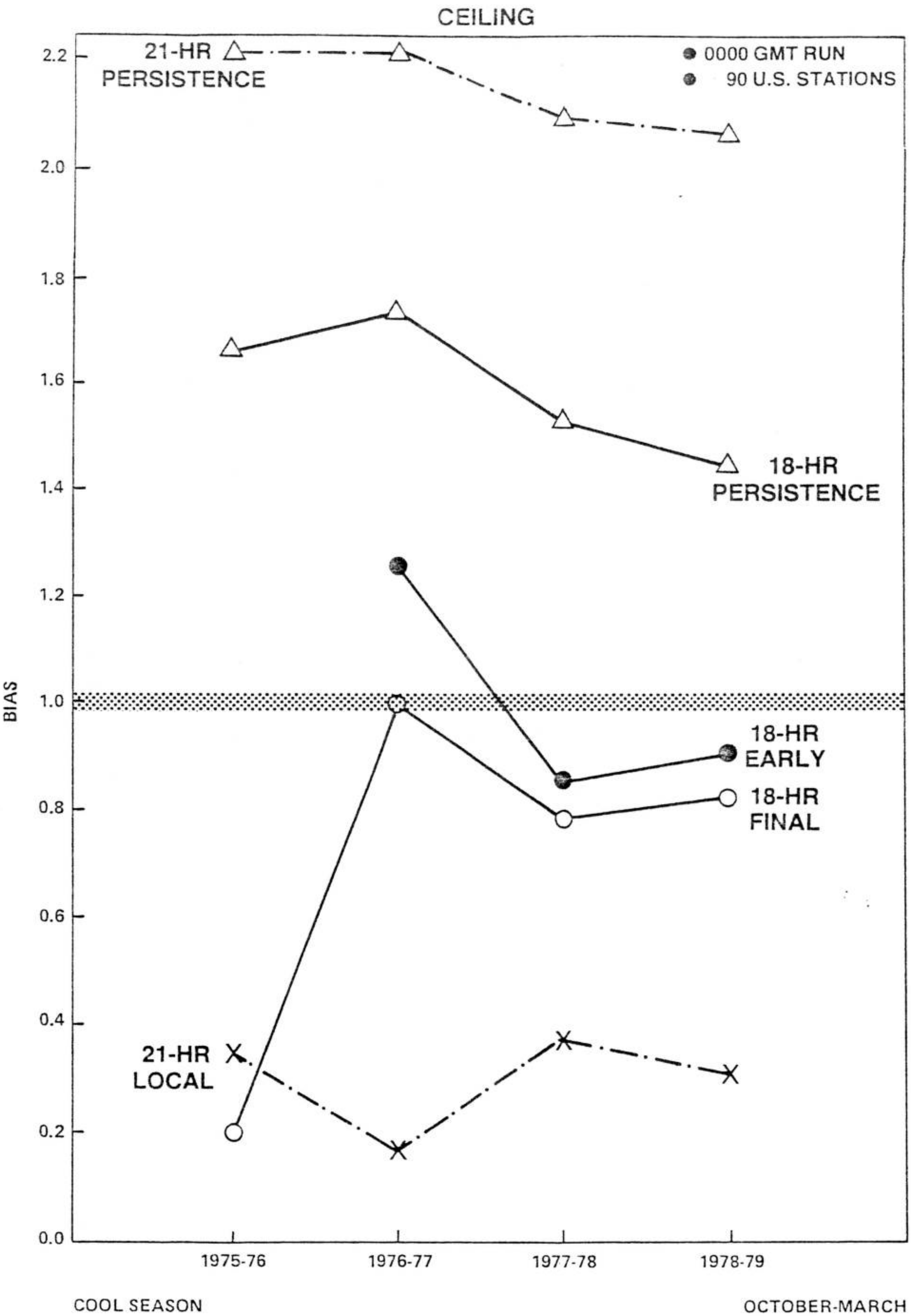

Figure 6.6. Same as Fig. 6.5.

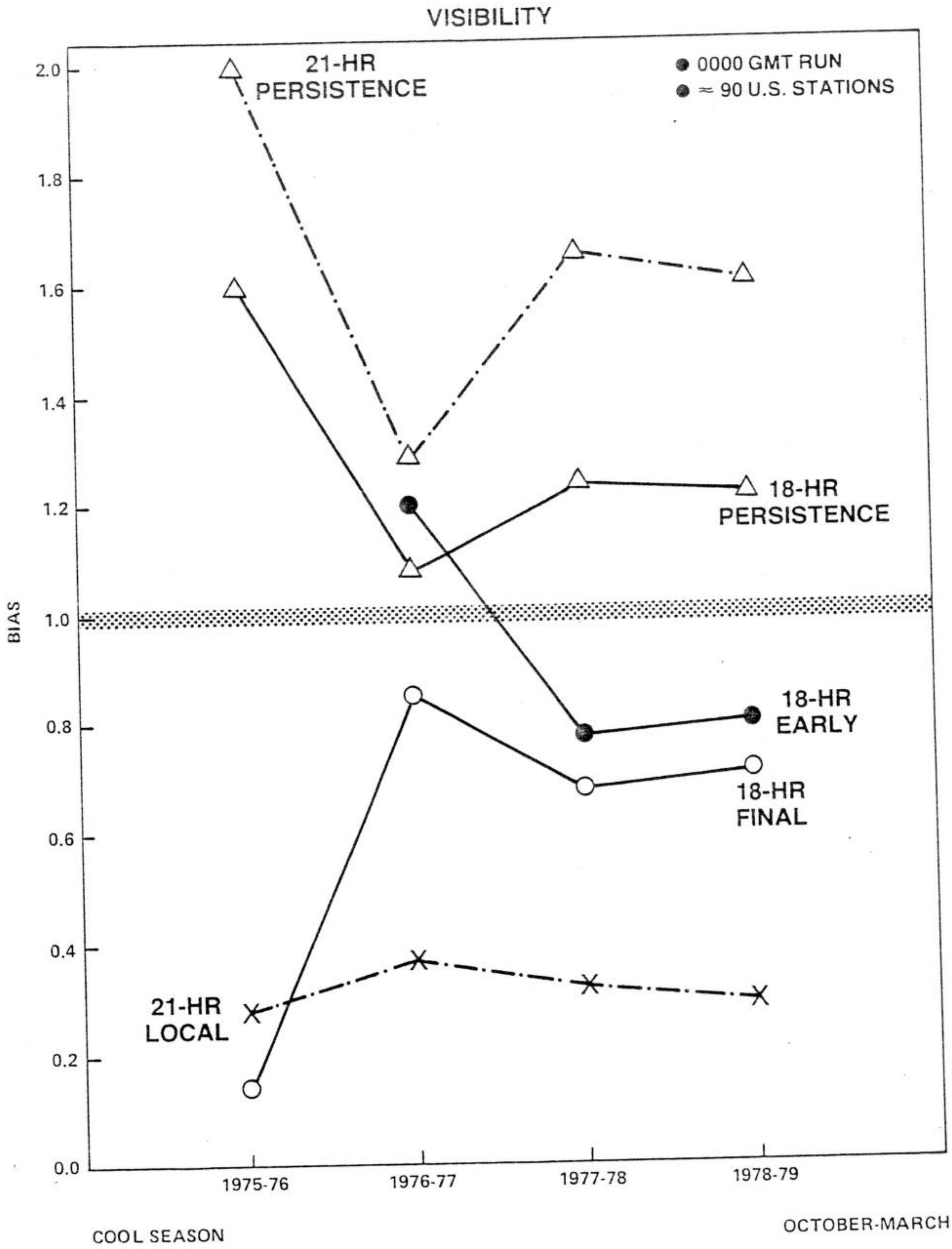

Figure 6.8. Same as Fig. 6.7.

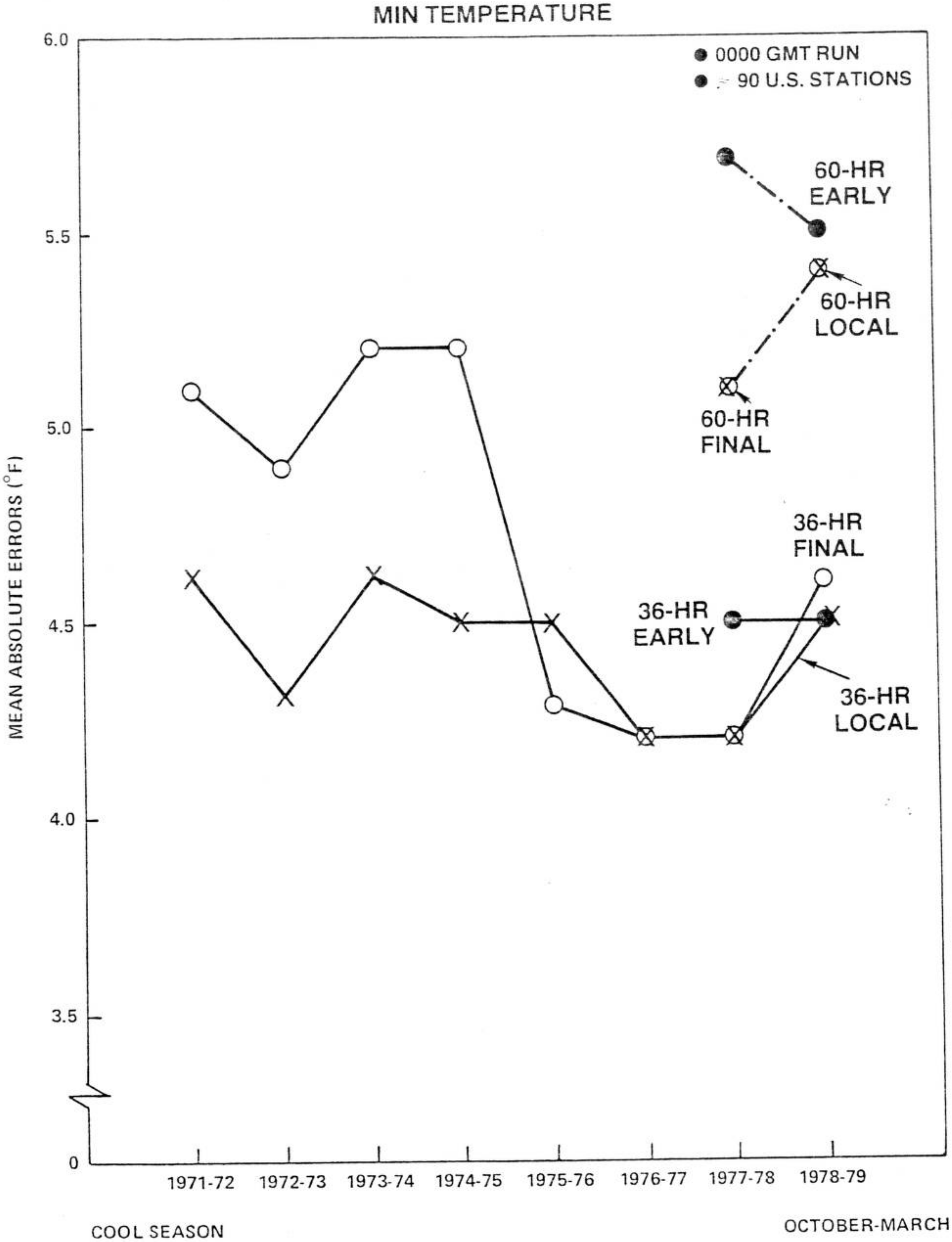

Figure 7.2. Same as Fig. 7.1 except for the min temperature forecasts.